

PATENT ABSTRACTS OF JAPAN

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(54) IMAGE PICKUP DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To perform excellent photographing day and night without changing a filter by a mechanical mechanism by providing an optical filter with the characteristics of changing transmissivity in a near infrared area corresponding to an incident light quantity to the optical filter.

SOLUTION: While the transmissivity of the optical filter 4 becomes uniformly high transmissivity (almost transparent) from a near ultraviolet area to the near infrared area when surroundings are dark, the transmissivity of the near infrared area becomes substantially low partially including the long wavelength area of a visible light area when the surroundings are bright. Also, when the surroundings are intermediately bright, it is continuously changed corresponding to the brightness (incident light

quantity) of the surroundings from time to time. Then, since spectroscopic sensitivity in a CCD image pickup element 1 is automatically and appropriately switched corresponding to the transmissivity characteristics of the optical filter 4 arranged on the incident light path, photographing is performed with excellent sensitivity day and night.

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CLAIMS

[Claim(s)]

[Claim 1]An image sensor which has sensitivity in a near infrared region.

A light filter provided on an incident light path to this image sensor.

It is the imaging device provided with the above, and said light filter has the characteristic that transmissivity in a near infrared region changes according to incident light quantity to this light filter.

[Claim 2]The imaging device according to claim 1, wherein transmissivity in a near infrared region of said light filter has a high direction when less than the time with much said incident light quantity.

[Claim 3]The imaging device according to claim 1, wherein transmissivity in a near infrared region of said light filter changes continuously according to said incident light quantity.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the imaging device provided with the change function of spectral sensitivity.

[0002]

[Description of the Prior Art]When taking a photograph conventionally at a bright place like daytime, using the image sensor which has sensitivity also in a near infrared region, When intercepting the light of a near infrared region using an infrared removal filter, using it as a color camera and taking a photograph at a dark place like night, the

photographing camera of the day-and-night combination which removes an infrared removal filter and is used as a high sensitivity black and white camera is developed.

[0003]It is changing this variable filter from such a viewpoint suitably, for example in JP,62-20477,A using the variable filter which can choose at least two or more wavelength ranges, and what can be photoed with sufficient sensitivity in both daytime and night is indicated.

[0004]

[Problem(s) to be Solved by the Invention]However, in what chooses a light-receiving wavelength range with an infrared removal filter or a variable filter, since the mechanism which changes a filter mechanical is needed, it becomes the hindrance of the miniaturization of a device, and a cost cut. The fall of the reliability resulting from the mechanical portion for a filter change existing is also produced.

[0005]There is a place which it was made in order that this invention might solve an aforementioned problem, and is made into the purpose in providing the imaging device which enables good photography over day and night, even if it does not change a filter by a mechanical mechanism.

[0006]

[Means for Solving the Problem]In an imaging device concerning this invention, it has composition provided with an image sensor which has sensitivity in a near infrared region, and a light filter provided on an incident light path to this image sensor. And a light filter is a thing with the characteristic that transmissivity in a near infrared region changes according to incident light quantity to this light filter.

[0007]In an imaging device which consists of the above-mentioned composition, if incident light quantity to a light filter changes with surrounding luminosities, according to this, transmissivity in a near infrared region of a light filter will change. That is, in a light filter, when the circumference is bright, transmissivity of a near infrared region becomes low (when there is much incident light quantity), and when the circumference is dark, transmissivity of a near infrared region becomes high (when there is little incident light quantity). Thereby, spectral sensitivity of an image sensor comes to be automatically changed according to the transmissivity characteristic of a light filter.

[0008]

[Embodiment of the Invention]Hereafter, it explains in detail, referring to drawings for an embodiment of the invention. Drawing 1 is a schematic diagram explaining one embodiment of the imaging device concerning this invention. CCD (Charge Coupled Device) in which the illustrated imaging device has sensitivity ranging from the intravital ultraviolet range to a near infrared region It has the image sensor 1. This

CCD image sensor 1 has a pixel of a large number arranged in the shape of area in that imaging surface (acceptance surface), and picturizes the photographic subject (candle with which fire was lighted in the example of a figure) 2 by changing into an electrical signal the light which received light in each pixel according to that light intensity (photoelectric conversion).

[0009]On the other hand, the digital disposal circuit 3 processes predetermined processing, for example, amplification, A/D (analog to digital) conversion, etc. to the electrical signal (picture signal) of the analog outputted from CCD image sensor 1.

[0010]On the front face of CCD image sensor 1 (imaging surface), i.e., the incident light path to CCD image sensor 1, the light filter 4 with the optical property mentioned later is formed. This light filter 4 is formed by the method on chip on CCD image sensor 1.

[0011]The characteristic of the light filter 4 in this embodiment is shown in drawing 2. In the figure, the wavelength of a vertical axis and light is taken for the transmissivity of the light filter 4 along a horizontal axis, and the filter characteristics are expressed by making the surrounding luminosity, i.e., the incident light quantity to the light filter 4, into a parameter.

[0012]Like a graphic display, when the circumference is dark (when there is little incident light quantity), To becoming high transmissivity (almost transparent optically) uniformly ranging from the intravital ultraviolet range to a near infrared region, as a figure inner substance line shows, when the circumference is bright, the transmissivity of a near infrared region becomes low substantially in the form which includes a part of long wavelength region of a light range as a figure destructive line shows (when there is much incident light quantity). In the interim luminosity the time when the circumference is dark, and when bright, the transmissivity of the light filter 4 in a near infrared region is changing continuously (stepless) according to the luminosity (incident light quantity) of the occasional circumference.

[0013]In the imaging device which consists of the above-mentioned composition, in order to change automatically and appropriately the spectral sensitivity in CCD image sensor 1 according to the transmissivity characteristic of the light filter 4 arranged on the incident light path, it becomes possible to take a photograph with good sensitivity all day and night.

[0014]For example, when taking a photograph at a bright place like daytime, the transmissivity of a near infrared region becomes low as the characteristic of the above-mentioned light filter 4, that is, since the light filter 4 functions as an infrared removal filter, it becomes possible to obtain the picture color (visible image) of a good

light range.

[0015] Since the transmissivity of a near infrared region becomes expensive [even it in a light range and an equivalent level] as the characteristic of the above-mentioned light filter 4 on the other hand when taking a photograph at a dark place like night, it becomes possible to take a photograph with very high sensitivity.

[0016] Thus, since the transmissivity of the near infrared region of the light filter 4 changes automatically according to the surrounding luminosity (incident light quantity to the light filter 4) according to the imaging device of this embodiment, Even if it does not change a filter mechanical like before, it can be used as a color camera daytime and can be used as a high sensitivity black and white camera at night. Since the mechanical operation sound by filter change does not occur at all, it becomes what was suitable when using it as a photographing camera the use for surveillance that a mechanical operation sound interferes with photography especially, for example, an object, and for nature observation.

[0017] Also in the case where the circumference becomes dark gradually or the circumference becomes bright gradually from the midnight to early morning from the daytime to night, It becomes possible to take a photograph with the spectral sensitivity which was always suitable for the surrounding luminosity from the transmissivity of the light filter 4 in a near infrared region changing continuously according to the occasional luminosity.

[0018] Although the composition which formed the light filter 4 in the front face of CCD image sensor 1 by the method on chip was illustrated in the above-mentioned embodiment, It may be made for this invention to form the light filter 4 not only in this but in the position (however, it carries out an incident light path top) which only a predetermined distance separated from the front face of CCD image sensor 1 as shown, for example in drawing 3 in combination with the optical elements (lens etc.) of independent or others.

[0019] As long as it has sensitivity as an image sensor concerning this invention not only in CCD image sensor 1 but in the near infrared region mentioned above, image sensors other than CCD may be adopted.

[0020]

[Effect of the Invention] In the imaging device applied to this invention as explained above, On the incident light path to an image sensor, even if it does not change a filter by a mechanical mechanism by having provided the light filter in which the transmissivity in a near infrared region has the characteristic of changing according to incident light quantity, according to the surrounding luminosity, the spectral sensitivity

of an image sensor can be changed automatically. This becomes possible to aim at the miniaturization, low-cost-izing, and the improvement in reliability in the photographing camera of day-and-night combination.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a schematic diagram explaining one embodiment of the imaging device concerning this invention.

[Drawing 2]It is a figure showing the characteristic of the light filter in an embodiment.

[Drawing 3]It is a schematic diagram explaining other embodiments of the imaging device concerning this invention.

[Description of Notations]

1 -- A CCD image sensor, 4 -- Light filter